Formalizing contemporary conceptual metaphor theory

A structured repository for metaphor analysis

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This paper describes an innovative formalization of Conceptual Metaphor Theory and its implementation in a structured metaphor repository. Central to metaphor analysis is the development of an internal structure of frames and relations between frames, based on an Embodied Construction Grammar framework, which then informs the structure of metaphors and relationships between metaphors. The hierarchical nature of metaphors and frames is made explicit, such that inferential information originating in embodied conceptual primitives is inherited throughout the network. The present analysis takes a data-driven approach, where lexical differences in linguistic expressions attested in naturally-occurring discourse lead to a continued refinement and expansion of our analyses.

Keywords: metaphor, Conceptual Metaphor Theory, Embodied Construction Grammar, Frame Semantics, automated metaphor identification, metaphor formalisms, lexical resources

1. Introduction

Since the development of Frame Semantics by Fillmore (1976, 1982, among others; see also Lakoff 1987) and the publication of Lakoff & Johnson's (1980) seminal *Metaphors We Live By*, the field of cognitive linguistics has grown into a mature discipline. Significant advances in Frame Semantics, particularly its instantiation in English FrameNet (Ruppenhofer et al. 2016) and versions of FrameNet in languages other than English and in construction grammar frameworks (Fillmore 1988; Kay & Fillmore 1999; Goldberg 1995; Bergen & Chang 2005; Feldman et al. 2009; Croft 2001; Fried & Östman 2004; Boas 2009, 2013) have led to robust

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models of frames and constructions.[1] These include established formalized representations and relations between frame elements, frames, and constructions at multiple levels of analysis, from lexeme to argument structure to grammatical constructs. The development of structured representations of semantic information in FrameNet (Petruck 2013) alongside the computational implementation of Embodied Construction Grammar (ECG) allows for a codified representation but also for an analysis that has the potential for verification and replication, which constitute vital elements of any maturing theory that boasts scientific rigor and cognitive validity. In contrast, Conceptual Metaphor Theory (CMT) has not been so far as rigorously formulated, unlike Frame Semantics and some versions of construction grammar. The present paper represents an effort to bring a standard formalization model to CMT.

1.1 Why formalize metaphor theory?

Major theoretical developments in the history of CMT include the identification of primary and complex metaphors (Grady 1997), hierarchical levels of metaphor specificity (Lakoff & Johnson 1999) and metaphor systems (Kövecses 2010), and the systematic relationship between constructions and metaphors (Croft 1993; Sullivan 2007, 2013). Additionally, significant advances in metaphor analysis, including the development of corpus methodologies (Stefanowitsch 2005; Stefanowitsch & Gries 2006; Deignan 2005) and systematization of metaphor identification (Pragglejaz Group 2007; Steen 2007; Steen et al. 2010) have allowed for both validation of metaphors across larger bodies of data and for a deeper analysis within small data sets. Early ventures in automated extraction (e.g. Mason 2004) have demonstrated some success in identifying metaphor in corpora, but in limited domains and without a substantial basis in theory. Within the cognitive neuropsychology domain, the embodied underpinnings of conceptual metaphor continue to be validated with both behavioral and neuroimaging studies (see Gibbs et al. 2004; Bergen 2012; Lakoff 2012 for overviews).

Despite these advances, several substantive criticisms of contemporary CMT remain (e.g. Gibbs 2009, 2011; Kövecses 2008, 2011; Pragglejaz Group 2007; Steen, 2007; Ruiz de Mendoza Ibáñez & Perez Hernandez 2011). One main issue is that CMT relies too heavily on the intuitions of the individual linguist at work and is insufficiently data-driven.[2] Because metaphor identification typically involves a

1. Other FrameNets include: Korean (Nam et al. 2014), Brazilian Portuguese (Salomão et al. 2013), Japanese (Ohara et al. 2004), and Swedish (Borin et al. 2009).

2. Discussion of broader criticisms regarding the psychological validity of CMT (e.g. McGlone 2007) is outside the scope of this paper, but this has been addressed substantially elsewhere (e.g. Gibbs 2009, 2011).

top–down analysis model relying on the analyst to intuitively recognize metaphoric language, it can be perceived as a circular reasoning process by which analysts only identify metaphors they were already looking for or only those metaphors of which they are already aware. Furthermore, because most metaphor analysis is performed by individuals or small working groups, data analysis must be relatively small-scale and limited to the amount of text a person is capable of parsing. In turn, this leads to criticisms of a lack of scientific rigor and objectivity, as well as the inability to replicate results; using external sources rather than purely relying on the analyst's intuition can increase agreement between analysts and improve consistency (Pragglejaz Group 2007).

One approach that has to some degree avoided the pitfalls of individual analyst-driven metaphor analysis is the corpus method approach, which relies on predetermined search terms (i.e., developing lists of source or target domain language to search for within corpora). This, however, can recapitulate the issue of analyses which only discover what the analyst already anticipates. Corpus methods serve to overcome the criticism that the top–down metaphor analysis draws general conclusions from few (sometimes constructed) data-points because a bottom–up, corpus-driven approach develops generalizations based on patterns corroborated by naturally-occurring data sets (Kövecses 2011).

Another criticism of CMT is that metaphor analyses are generally seen as being too prose-based and descriptive; metaphors identified within a text are named in the "TARGET-DOMAIN IS SOURCE-DOMAIN" format first established in Lakoff & Johnson (1980) and then further elaborated upon in prose discussion. Taxonomic, hierarchical relationships between metaphors are similarly under-developed; some classification of types of metaphors has been proposed, based on such criteria as source domain structure, levels of genericity, and types of mappings (Barcelona 2000; Ruiz de Mendoza Ibáñez & Perez Hernandez 2011). We argue that these taxonomic relations require further development and codification because, while there is apparent systematicity in sets of related linguistic expressions, the *nature* of that systematicity is still under-developed. While the compositional nature of metaphor has been observed (Grady 1997; Lakoff & Johnson 1999; Yu 2011), the details of this compositionality are generally limited to contrasts between primary and complex metaphors. To illustrate, consider an excerpt from Lakoff & Johnson's (1999) analysis of the Location Event Structure Metaphor (Figure 1): it constitutes a list of related metaphors, accompanied by a chapter-length discussion of the metaphor family. While the structure of this list is discernable to the attentive reader, any structural relationships between the metaphors are not made explicit, and thus left to intuition. This paper seeks to address the absence of a *formal* representation of the structure of metaphors and relationships between metaphors.

The Location Event-Structure Metaphor

States Are Locations (interiors of bounded regions in space)
Changes Are Movements (into or out of bounded regions)
Causes Are Forces
Causation Is Forced Movement (from one location to another)
Actions Are Self-propelled Movements
Purposes Are Destinations
Means Are Paths (to destinations)
Difficulties Are Impediments To Motion
Freedom of America Is The Lack of Impediments To Motion
External Events Are Large, Moving Objects (that exert force)
Long-term, Purposeful Activities Are Journeys

Figure 1. Early analysis of the Location Event Structure Metaphor (Lakoff & Johnson 1999: 179).

We propose and describe a system for frame and metaphor representations that has been implemented in a metaphor repository. Our analytical framework provides a formalization of CMT not previously found in the literature, which requires substantial representation of elements within individual frames and relations between frames, as well as relations both within and across metaphors. These relations are not just prose labels but contentful definitions constituting theory-driven analysis of the structure of frames and metaphors. These definitions are subsequently employed in a computational metaphor extraction and metaphor modeling system, and are subject to consistency checking (Hong, this volume).

Prior approaches to developing metaphor databases have not focused on representing relationships between frames and metaphors or the internal structure of frames. MetaBank contains a knowledge base of literal and metaphorical English word senses (Martin 1994). The represented information includes source concepts, target concepts, and metaphors as based on the Berkeley Master Metaphor List (Lakoff et al. 1991). However, it explicitly does not attempt to relate metaphors hierarchically or analyze the structure of metaphors. It can identify relative frequencies of known metaphors, but does not provide a mechanism to leverage the current knowledge base to identify new metaphors. The ATT-Meta system databank (Lee & Barnden 2001) also makes use of the Master Metaphor List; it comprises a set of hand-collected and annotated examples of conceptual metaphors in English, particularly metaphors of the mind. Each example is annotated for source and target domain information. Metaphors are not represented hierarchically beyond very minimal tree structure (e.g. CREATING IS MAKING VISIBLE is nested within COGNIZING IS SEEING). The databank was developed for validation purposes and does not represent relationships between metaphors or source and target domains; the process of adding new entries is not scaffolding by existing entries in the databank nor are new entries constrained by the structure of the extant data.

The Italian Metaphor Database (Alonge 2006) and the Hamburg Metaphor Database (Lönneker-Rodman 2008) are both concerned with representing conceptual metaphors as commensurate with cognitive linguistic theory. The Italian Metaphor Database sought to represent hierarchical and opposition links between metaphors and metaphorical senses in Italian WordNet. For example, NOTO È AVANTI (THE KNOWN IS AHEAD) is coded as having the opposite metaphor IGNOTO È DIETRO (THE UNKNOWN IS BEHIND). However, the representation of the links is not specified beyond a few examples, nor is the nature of the hierarchical structure clear. The Hamburg Metaphor Database is a hand-collected database of metaphorical linguistic expressions in French and German; the data is annotated for source and target domains and source and target-evoking lexemes. Both of these databases also rely on the Master Metaphor List; however, Lönneker-Rodman (2008) notes some issues with this approach. Because the listed metaphors are at varying levels of specificity but are not arranged in a coherent hierarchy, annotators find it difficult to select the correct level of specificity. The list is also incomplete and is missing certain primary concepts.

One advantage of this formalized system is the generalization of representation at multiple levels of analysis, thus enabling CMT to move beyond localized observations not extensible beyond particular data sets or constrained by the unstructured and limited Master Metaphor List. Such formalization results in a large-scale network beyond what any individual analyst could produce and a resource that is accessible to multiple analysts, such that the network can be searched and visualized at multiple levels of granularity. Its computational implementation allows for corpus-based metaphor analysis and identification of novel metaphors (see Hong, this volume, for automated metaphor extraction; Dodge, this volume, for corpus analysis). By requiring the analyst to adhere to a formal representation, the system is both descriptive and predictive in nature. Thus, 'gaps' in the network indicate areas of analysis requiring further investigation, which can then be tested and cross-validated across multiple data sets, including cross-linguistic comparisons. Furthermore, the network's scalability allows for easy addition of metaphors and frames as analysts refine and expand the data in the repository, without affecting the robust nature of the system. The implementation of a formalization scheme also facilitates system-internal accuracy checking as well as an external extension of the system into other applications. Formalization of metaphor theory aligns CMT with the current and future goals of Frame Semantics and Embodied Construction Grammar in terms of representation and analytical power and allows for the possibility of addressing many of the current criticisms of CMT.

1.2 Roadmap

We first describe in brief the theoretical underpinnings of CMT, including the nature of semantic frames and their relation to metaphors in Section 2. Then, we detail how frame analyses are developed in service of metaphor analysis; these frames and their ensuing conceptual network form the basic conceptual structure on which metaphor theory depends. After discussing the internal structure and logic of frames in Section 2.2, we define and illustrate a set of relations between frames in Section 3, which provides the structure of the network itself. Given that metaphors are bundles of mappings between frames, we then turn to conceptual metaphors themselves. We show that an internal frame structure, including analysis of individual frame elements, is crucial to formalizing metaphor structure. Finally, in Section 4, we present an improved understanding of the relationships between metaphors at varying levels of specificity, as driven by the underlying relationships between the frames that comprise the source and target domains of the metaphors.

2. Development and formalization

2.1 Background

The framework developed here reflects several fundamental premises shared across cognitive semantics (Clausner & Croft 1999). The main level of analysis, variously referred to as a frame, base, or domain in the literature (Fillmore 1976; Langacker 1987, 2008; Lakoff 1987), comprises the cognitive structures that support and define basic semantic concepts. Central to Frame Semantics is the notion that frames are structured, not just associated lists of semantic concepts or conditions; they are schematized experiential representations of world knowledge (e.g., Petruck 1996). Moreover, frames are taxonomically related to one another: there are varying degrees of generality and specificity, such that some frames instantiate more general ones and certain basic-level frames constitute primary bodily experiences (Clausner & Croft 1999). As metaphors are cross-domain mappings between frames, they are also structured, both in terms of the internal structure of individual metaphors and the structured relationships between metaphors. The goal of this project is to formalize and implement these frame and metaphor structures.

Current CMT does not typically incorporate Frame Semantics in any codified manner; individual analyses identify particular roles within source and target domains but the issue of which frame elements to include relies on the discretion of the analyst without any agreed-upon state of the art, including what kind of and how many frame elements to include in the metaphoric mappings. At present, representation of relations between frames, such as inheritance of frame elements,

is typically not incorporated into CMT analyses. Instead, there is an accepted general understanding in CMT that the source and target domains of metaphors are composed of frames or image schemas. In recent years, increasing attention has been paid to the need to incorporate more detailed frame analysis into CMT (e.g. Bouveret & Sweetser 2009; Moore 2006, 2011; Sullivan 2006, 2013).

The development of MetaNet frames owes much to the instantiation of Frame Semantics in FrameNet. Since its establishment in 1997, FrameNet has come to define the structure of semantic frames, including core and peripheral frame elements and relations between frames. As will be discussed in Section 3.2, FrameNet's frame-to-frame relations inform MetaNet's formalization of frame relations. The notion of the frame as a cohesive experiential gestalt underlies both MetaNet's and FrameNet's frames. While they share these central conceptual tenets, instantiation of a particular concept may vary between the two databases; MetaNet (MN) frames are not based directly on FrameNet frames but are developed in the process of metaphor analysis, as will be further described in Section 4.3.1. Consider, for example, the English verbs *rise* and *fall*. Together, both lexemes evoke the concept of *directional motion*. Both FrameNet and the MN repository have frame entries reflecting such a concept: Motion_directional (FrameNet) and Motion Along a Path (MetaNet). FrameNet defines it as "a Theme moves in a certain Direction which is often determined by gravity or other natural, physical forces"; the analysis in MN's repository informally describes it as "A moving entity (the mover) starts out in one place (Source) and ends up in another place (Goal), having covered some space between these two (Path)". In both cases, there is a notion of translational motion by an entity in a direction. However, while *rise.v*[3] and *fall.v* are both included in the Motion_directional lexical entries, they are not in the list of Motion Along a Path lexical units. Instead, *rise.v* is in Upward Motion, and *fall.v* is in Downward Motion, both of which are more specific frames that inherit their structure from Motion Along a Path. In MN's system, splitting frames into these finer-grained concepts is driven by their frequency of use in metaphoric constructs; this process is described in detail in Section 2.2.1 and illustrated specifically for vertical motion in Section 4.3.1. The tendency for frames in MetaNet to be more 'split' rather than 'lumped' is driven in part by the frequent importance of opposing endpoints of scalar regions in metaphoric entailments. In the case of vertical motion, the scalar perspectives of 'up' and 'down' lead to critical differences in inferential structure. The metaphor CHANGE IN QUANTITY IS CHANGE IN VERTICALITY is in usage realized in terms of either Upward Motion or Downward Motion, as will be further shown in Section 4.3.1; therefore, representing them as separate frames is appropriate. We are not claiming that this approach is in

3. The .v suffix on the lexical entry indicates it is a verb; .n indicates a noun.

general a better method for frame representations; rather, it is specifically tailored for metaphor analysis.

MN's conceptualization of frames also draws on other concepts within cognitive linguistics, particularly Langacker's (1987, 2008) notion of a *scene*. While FrameNet represents causal and non-causal variations of a process as separate frames, MN distinguishes between a core *scene* (to be discussed further in Section 2.2) and its causal and aspectual variants (to be discussed further in Section 3.2). Therefore, a causal process such as Cause Motion Along a Path is a variant on the Motion Along a Path scene, instead of a separate conceptual entity.

2.2 Frames

As Grady (1997) first demonstrated, primary metaphors such as KNOWING IS SEEING and STATES ARE LOCATIONS consist of experientially-based embodied universals, including primitives variously referred to as *image schemas* or *cogs* (Talmy 1983; Lakoff 1987; Lakoff & Turner 1989; Johnson 1987; Gibbs & Colston 1995; Lakoff & Johnson 1999; Dodge & Lakoff 2005; Gallese & Lakoff 2005). We consider image schemas to be those conceptual gestalts that are directly embodied, likely universal, and structure everyday experiences (e.g. Dodge & Lakoff 2005). For example, MORE IS UP (or, more generally, QUANTITY IS VERTICALITY), comprises the notion of Quantity in the target domain and the image schema of Verticality in the source domain, with the experientially-based inference that upwards motion constitutes an additive property. In contrast, many conceptual metaphors are not composed of relations between experiential universals, but between culturally-constrained semantic frames. LOVE IS A JOURNEY (or, A ROMANTIC RELATIONSHIP IS A JOURNEY) (e.g. Lakoff & Johnson 1980) requires culturally specific notions of what constitutes both a romantic relationship and a journey with an intended destination. Hence, frames are complex gestalts comprising culture-specific elements with experiential grounding; in contrast, cogs/image schemas are taken to be conceptual primitives grounded in universally shared human bodily experiences.

From its initial design stages, our project has been intended for cross-linguistic comparison, in part because CMT is theorized to derive from the cross-cultural universal experiences driving embodied cognition. Given that metaphoric source and target domains can be made up of universal primitives, of culturally specific frames, or of some combination of the two, MetaNet treats both universal and culturally specific structures as *frames*. It views frames as coherent semantic and cognitive structures, formed from bodily interaction with the world. In the case of culturally-specific frames, this interaction includes one's sociocultural experiences. Frames are then proposed to be analyzed as either culturally-bound frames or image schemas to enable the validation of these universals and a cross-cultural

comparison of frames. When a particular conceptual metaphor is validated cross-linguistically, it provides evidence both for the universal nature of the metaphor and for the image schemas that make up its source and target domains[4].

Altogether, the MetaNet repository represents the complex conceptual network that speakers of particular language have as comprising inter-connected frames and metaphors. These frames and metaphors are embodied mental representations of the speakers' experiences. The conceptual network is therefore itself a representation of a particular embodied worldview. Part of the goal of MetaNet is to represent the more universally shared representations (posited to be the basis of primary metaphors and image schemas) as well as the culturally-specific ones.

MN further divides the representation of frames into two types: *Scenes* and *Perspectives*. *Scenes*, following Langacker (1987), define the structure of a coherent conceptual gestalt; they provide the conceptual content of a perceived situation. *Perspectives* provide the aspectual and causal elaboration on that scene (discussed in detail in Section 2.2.2). For example, the Harm *scene*, as further discussed in Section 2.2.1 below, has a defined structure that includes the entity that experiences the harm, the process of harm, the cause of the harm, and so on. Different *perspectives* on the harm process include *aspectual* variations: beginning to experience harm, ongoing experiencing harm, resumption of experiencing harm, etc. They also include *causal* variations, such as a cause to begin experiencing harm and a cause to cease experiencing harm.

2.2.1 *Analysis of frame elements and lexical units*

In the currently-described system, frames are developed specifically in the service of metaphors, rather than independently; hence, a frame is created or derived from another, more general frame when a metaphor is identified that has that frame as its source or target domain. For example, the Motion Along a Path frame and the Action frame are established in order to model the metaphor ACTION IS MOTION ALONG A PATH. In other words, frames are developed as a result of a continuous process of annotation and analysis of metaphors. Furthermore, frames can serve as the source or target of multiple metaphors, whereby different elements of that frame may be activated in each of the metaphors. For example, compare (1a) and (1b) (source domain language italicized, target domain language underlined):[5]

4. Following traditional terminology, we will continue to refer to the frames that comprise the source and target of the metaphor as the source domain and target domain. However, at a conceptual level we understand them to be frames as defined in Section 2.2.

5. Examples are from the English GigaWord corpus (Graff & Cieri 2003) or the British National Corpus (2007) except where otherwise noted.

(1) a. crime and corruption have *infected* virtually every aspect of the Russian economy[6]
b. High taxes and wage freeze (*sic*) *rob* people of a meaningful living[7]

In (1a), crime is metaphorically conceptualized as an infectious process; it is the target domain of the metaphor CRIME IS A DISEASE. In contrast, crime (i.e. robbery) is the source domain of the metaphor evoked in (1b), TAXATION IS THEFT, where high taxes are conceptualized as the criminal activity of theft. Hence, these analyses do not distinguish between 'core' and 'non-core' roles for a particular frame, because different elements are involved in different metaphor mappings, instead of a core set of elements involved in all mappings that the frame contributes to semantically. The focus on metaphor analysis in the creation of frames has thus led to the reinforcement of the notion of a frame as a bundle of roles, which interact with other roles in metaphoric mappings, as emphasized in the original works in both Frame Semantics and CMT.

Additionally, the Invariance Principle — which states that a metaphor only maps elements of the source domain onto the target domain such that they remain coherent in the context of the target — dictates that metaphors always involve *partial* mapping between source and target domain (Lakoff 1990). Only structurally-coherent and topology-preserving mappings between source and target domain are possible; any given instance of a particular metaphor may evoke some, or all, of these potential mappings. In effect, the Invariance Principle delineates what *can* be mapped between source and target domain, rather that what necessarily *is* mapped in any given evocation of metaphor. Given this partial schematicity inherent to metaphoric mapping, not *all* elements of a frame are expected to be engaged in the internal structure of a metaphor. Our project's frame roles are added and elaborated upon as additional metaphors making use of particular frame roles are analyzed. For instance, the vehicle role may be added to the Journey frame only once it is evident that RELATIONSHIPS ARE VEHICLES is a mapping in the LOVE IS A JOURNEY metaphor. Only as many frame elements are initially added to a frame as are needed to account for the mappings that frame and its roles participate in, with room for expansion once additional roles are discovered via the analysis process and as needed in other mappings.

The coherence of mappings between source and target domain is maintained in part by constraining which roles can map onto one another. These constraints

6. ENGW_apw_eng_199611:44236

7. ENGW_xin_eng_200402:35272

are accomplished via *role typing*,[8] in which the roles of a frame can only be filled by role fillers of a particular type; types are themselves high-level (highly schematized) frames. For example, in the Harm scene frame shown in Figure 2, the thematic harmed_entity role, which undergoes the experience of harm, must be something that *can* be harmed, i.e. an entity of some kind. In contrast, a process cannot be harmed because it is not a 'thing' of some kind; rather, it is a sequence of events with temporal duration. Because the Harm scene is a very generalized frame, it does not specify *what* the harmed_entity is; it could be any type of physical entity, regardless of animacy or personhood. Hence, the harmed_entity role is just typed as an Entity.

We can link the harmed_entity role within the Harm frame to the harmed_entity role within the Physical Harm frame and the victim role within the Harm to Living Entity frame. Harm and Harm to Living Entity are essentially progressively more specific versions of the more general Harm frame. Each adds further specification to the roles of the frame such that the harmed_entity is a physical entity and subsequently an animate, living entity of some kind. The harmed entity of the Harm to Living Entity frame is thus termed a 'victim', which appropriately invokes a notion of harm to an entity that undergoes a detrimental, negative experience as a result of the harm. Contrast this situation to the harmed_entity that, while damaged, may not have a 'negative' experience if it is an inanimate object that cannot be conceptualized as a true semantic patient experiencing something detrimental to itself. The victim role is further constrained to be of type Animate Entity, which provides this specification. Additionally, the Harm scene does not specify that the harm be *physical* harm to a *physical* entity; this is determined in the Physical Harm frame and the roles within are typed accordingly. (Other frames that specify different types of harm include Environmental Harm and Psychological Harm, each with their own role typing-based constraints.) Notably, just as the victim is a particular kind of harmed_entity, so too is the Animate Entity *type* a particular kind of Entity *type*. Frame role types are themselves frames; for example, the Animate Entity *type* and Entity *types* are the Animate Entity frame and the Entity frame.

8. A reviewer observed that *role typing* is similar to Grady's (2008) *superschemas*. In his approach, superschemas are "elements of conceptual structure shared by source and target concepts of…metaphors" (Grady 2008: 351). For example, both source and target of SIMILARITY IS PROXIMITY comprise scalar relations between two entities. In this approach, this type of structural compatibility is shared between source and target domains, as well as between non-metaphoric structuring relations between frames. Furthermore, superschemas are even more abstract than image schemas, whereas role type constraints can be quite specific. For example, the entity role in Psychological Harm is typed to be a Sentient Entity; non-sentient entities do not experience psychological harm.

Roles:

Role Name:	harmed_entity
Role Type:	Entity
Definition/Comments:	

Role Name:	harmful_process
Role Type:	Process
Definition/Comments:	

Role Name:	effect_of_harm
Role Type:	
Definition/Comments:	damage caused by process

Role Name:	consequence_of_harm
Role Type:	
Definition/Comments:	results of damage, e.g. loss of function

Role Name:	cause
Role Type:	
Definition/Comments:	

Figure 2. Roles in the Harm scene frame.

Therefore, the role types have frame relations as well; the Animate Entity role type, as a subcase of Entity, inherits the structure of the Entity frame.

Just as FrameNet frames are evoked by lexical units, MetaNet frames similarly are associated with lexical units (LUs). Association of LUs with frames is developed via linguistic metaphor analysis: when a linguistic metaphor (i.e. an instance of a conceptual metaphor) is identified, the metaphor-evoking language is noted. This may consist of words evoking the source domain or both source and target. These LUs are then associated with the appropriate frame constituting the source or target of the conceptual metaphor (CM). LUs are only assigned to a particular frame with data-based verification that a specific LU evokes that particular frame in a linguistic metaphor (LM). LMs are linguistic expressions that instantiate conceptual metaphors linguistically, to be distinguished from visual metaphors or, more generally, conceptual metaphors. As metaphors are further analyzed and added to the network, so too are additional frames; these additions result in the re-assignment of LUs to different frames as a reflection of refined analyses. For instance, *push.v* may initially be assigned to the Caused Motion frame, but may subsequently be reassigned to a Forceful Caused Motion frame if such a split is justified in the frame structure (whereas Caused Motion is left neutral as to the forcefulness of the causal action).

Consider the conceptual metaphor ONGOING NEGATIVE STATE IS EXPERIENCING PHYSICAL HARM, as illustrated by the following LMs:

(2) a. my debt is *killing* me[9]
b. alleviate the debt *burden* on poor countries[10]
c. poverty *robs* people of dignity and health[11]
d. a region wracked by a *crushing* poverty[12]
e. debt *endangers* Iraq's long-term prospects for political health and economic prosperity[13]

An initial analysis of the linguistic metaphors in (2) might reveal that the continuing experience of a negative state (being in debt or being poor) is conceptualized metaphorically as the experience of some kind of harm. Hence, we develop an Ongoing Negative State frame to denote the experience of a negative state like indebtedness or poverty, and a Harm frame to denote the experience of Harm. We assign the corresponding LUs to the Harm frame:

Harm
kill.v
burden.v
crush.v
rob.v
harm.v
suffer.v

Further analysis, bolstered by discovery of additional LM instances, leads the analyst to reconsider ONGOING NEGATIVE STATE IS EXPERIENCING PHYSICAL HARM, and propose an additional CM: ONGOING NEGATIVE STATE IS BEING THE VICTIM OF A CRIME.[14]

These new CMs, in turn, lead to the development of additional frames, where the LUs evoking these frames are reassigned:

9. http://www.popsugar.com/smart-living/Maxed-Out-My-Debt-Killing-Me-2425114

10. ENGW_afp_eng_200410:6142

11. http://borgenproject.org/impact-poverty-life-expectancy/

12. ENGW_apw_eng_200207:1175

13. ENGW_xin_eng_200312:12106

14. Most likely, the analyst would also propose that Ongoing Negative State be further divided into into Debt and Poverty frames as well; this is reflected in the current network.

Physical Harm
kill.v
burden.v
crush.v
Crime
rob.v

Notably, because the LUs *suffer.v* and *harm.v* don't particularly evoke the frames of either Physical Harm or Crime, they remain in the Harm frame. The new frames, together with the original Harm frame, instantiate a Harm subnetwork as shown in Figure 3. The arrows indicate frame relations; specific types of frame relations will be discussed in Section 3.

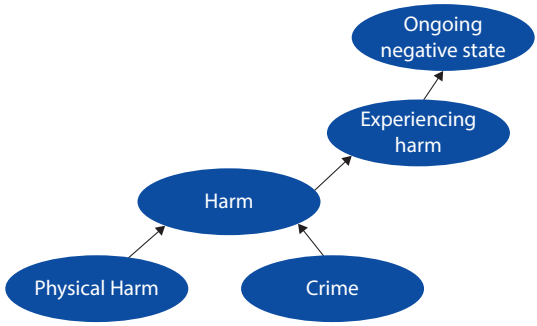

Figure 3. Harm frames subnetwork.

As additional LMs are discovered, either by the analyst or via the automatic extraction system, this aspect of the frame network would be elaborated further with additional frames and LUs. Additional differentiation of frames is guided by several considerations. First, analysts will add frames that are lexically instantiated by metaphoric expressions. For example, the analyst might observe that in addition to (2c), other lexemes evoking Theft, such as in ***stealing*** *time*, ***robbed*** *me of my health*, and ***poached*** *his idea*, are frequently used in metaphoric contexts as well. This would motivate the addition of a Theft frame that inherits from Crime. Importantly, the additional frame must also carry critical inferential distinctions that are not already conveyed by the parent frame. In the case of Theft, it adds the inference that the criminal takes something of importance from the victim, leading to the entailment that *time*, *health*, and *ideas* are valuable things that can be 'taken'. In contrast, a Rapid Upward Motion frame would not be added because the only difference between it and Upward Motion is that it specifies the *rate* of motion, which is not specific to Upward Motion. Given that all motion has speed, this information should be provided at a more generic level rather than repeatedly represented through all specific variants of motion.

2.2.2 *Shared frame structures*

A feature of the representation of frames is the systematization of the structural and temporal nature of frames themselves, similar to the FrameNet implementation of relations between frames. Based on observation for any particular scene, a frame's structure must include particular structural components: entity role(s); non-entity role(s); relations between those roles if more than one exists; and an executing schema, or x-schema (Bailey 1997; Narayanan 1997; Bergen & Chang 2005),[15] which is a process frame, specifying the temporal structure of the state or event the frame encodes.[16] Entity roles are distinguished from non-entity roles, which can be considered as similar to Langacker's (1987) distinction between [THING] and [ATEMPORAL RELATION].[17] [THING]s are typically evoked by nouns, as are entity roles, and are conceived of as coherent gestalts. In contrast, Processes, which are typically verbs and correspond to x-schemas, are dynamic and understood as a series of changes or transformations. Atemporal relations correspond to MN's non-entity roles and are similar to Things in that they lack the dynamicity of Processes; they characterize the relationship between entities or processes. Compare two frames, the universal image schema Motion Along a Path and the cultural frame Corruption, to illustrate. Whereas semantically they are quite different, observe the structural similarities, as summarized in Table 1.

Table 1. Roles and relations in two frames.

	Motion Along a Path	**Corruption**
Entity role(s)	mover	corrupt_actor; harmed_entity; corruption_affectee
Non-entity role(s)	Source-Path-Goal image schema	corruption_effect
X-schema	motion process	corruption_activity
Inferences	mover begins at source; mover moves along path; mover progresses towards goal; mover performs motion process	corruption_effect effects corruption_affectee; corrupt_actor performs corruption_activity

15. X-schemas are formally based on Petri nets (Reisig 1985; Murata 1989).

16. While not conceptualized as events per se, we take the approach that statives are eventualities that incorporate temporal structure; ongoing or durative states must necessarily be experienced over some expanse of time.

17. We diverge from Langacker (1987) in that we do not specify the word classes of entity roles, non-entity roles, and processes; we only recognize the tendencies of correlations between role types and word classes.

Both Motion Along a Path and Corruption are scenes, despite their differences, i.e., the former is a universal image schema based on embodied experience, and the latter is a highly culturally defined frame. Still, both frames comprise the same basic structural components and the specifics of these components define any given frame.

For example, both the Motion Along a Path frame and Corruption frame have entity roles; Motion Along a Path has the entity in motion (mover) and Corruption has the entity performing the corrupt action (corrupt_actor), an entity affected by the corruption (corruption_affectee), and other entities harmed by the corruption (harmed_entity). The frames have non-entity roles, which are relations between entities and processes: the Source-Path-Goal schema in Motion Along a Path and the corruption_effect in Corruption. Each frame has x-schemas, representing Processes: the motion_process of Motion Along a Path and the corruption_activity of Corruption. Finally, each has a set of inferences that arise from the structure of the frame, in particular the relationship between entities and processes. In the Motion Along a Path frame, the Source-Path-Goal image schema relates the mover to the components of the motion process. In the Corruption frame, the corruption_affectee and corruption_actor entities are related to the corruption_effect and corruption_activity.

Returning to the Harm frame presented earlier, note that many of the elements of Corruption correspond to elements of Harm (Table 2):

Table 2. Relationships between roles in Harm and Corruption frames.

	Harm	**Corruption**
Entity role(s)	cause_of_harm; harmed_entity	corrupt_actor; harmed_entity; corruption_affectee
Non-entity role(s)	effect_of_harm	corruption_effect
X-schema	harmful_process	corruption_activity
Inferences	effect_of_harm harms harmed_entity; cause_of_harm causes harmful_process	corruption_effect effects corruption_affectee; corruption_effect harms harmed_entity; corrupt_actor performs corruption_activity

Thus, essentially, Corruption is an instance of a Harm frame with semantically elaborated roles and additional structure. Note in particular that these frames thus far are underspecified with regards to the dynamic or causal state of the given scene. For example, while the Motion frame has a mover agent to *perform* the motion x-schema, a scene does not specify whether the mover is currently in motion, if it is about to be in motion, or if the motion is caused to occur, and so on. Scene frames constitute structural, rather than dynamic, information; they define the structure of a frame, including the entities, x-schemas, relations, and inferences

of a frame. These structures are set and do not vary between perspectives on the frame. A set of related frames constituting aspectual and causal *perspectives* provide these temporal and causal options for scenes. Additionally, scene frames do not take a particular viewpoint on a scene but can have multiple viewpoints. This is similar to the structure in FrameNet, where, for instance, Buying and Selling are perspectives on a Commercial Transaction.[18]

While scenes provide structural and semantic information, perspective frames specify the values of the x-schema role of the related scenes, which constitute the possible temporal and causal values of the state dynamics of an eventuality, as listed in Table 3 and illustrated in part for Motion Along a Path. Perspectives include x-schema stages (Feldman 2006; Narayanan 1997; Feldman & Narayanan 2004) as well as causal variants of those stages. Aspectual and causal perspectives are integral to the conceptual network as a whole; given that more specific Processes, such as Motion Along a Path, share the same basic conceptual information as the generic Process schema, it follows that they also have all the same perspectives. Both scenes and perspectives represent types of conceptual structures; scenes specify the content (i.e. roles and processes) of frames, while perspectives provide

Table 3. Causal and aspectual variants of processes.

	Perspectives of a Process	**Motion Along a Path Perspectives**
X-schema stages	Begin process	Begin moving along a path
	Ongoing process	Motion along a path
	Interrupt process	Interruption of motion along a path
	Resume process	Resumption of motion along a path
	End process	Stop moving along a path
Causal variants	Cause to begin process	Cause beginning motion along a path
	Enable to begin process	Enable beginning to move along a path
	Prevent from beginning a process	Prevent beginning motion along a path
	Cause interruption of process	Cause interruption of motion along a path
	Enable interruption of a process	Enable interruption of motion along a path
	Prevent interruption of process	Prevent interruption of motion along a path
	Cause resumption of process	Cause resumption of motion along a path
	Enable resumption of process	Enable resumption of motion along a path
	Prevent resumption of process	Prevent resumption of motion along a path
	Cause end of process	Cause end of motion along a path
	Enable end of process	Enable end of motion along a path
	Prevent end of process	Prevent end of motion along a path

18. MetaNet's frame relation "profiles part of" is similar to the FrameNet frame-frame *perspective on* relation in this regard.

additional temporal and causal information. These are all conceptual gestalts — which is to say, types of frames — with different functions.

This kind of detailed event structure breakdown of frames is resonant with the detailed force-dynamic and causal image schemas that Talmy introduced and elaborated (1983, 1985, 2003). He notes that complex causal structures and finer-grained force-dynamic distinctions such as these are necessary to account for both the vast range of conceptualization and profiling patterns within a language, as well as for cross-linguistically comparable patterns as well. The typology of frames and roles in our ontology is intended to capture these valuable generalizations, much as subsequent developments of force-dynamic and causal schemas do (such as Narayanan's 1997 x-schemas and the grammatical structures in Embodied Construction Grammar in Bergen & Chang 2005).

Specifying additional aspectual stages to fulfill the x-schema parameter of a particular scene provides additional aspectual information for that scene. While this temporal and causal structure underlies all eventualities and, hence, all scenes, it is the specifications of the metaphors under analysis that drive the analysis of particular perspectives in MN's frame network as they are represented in the MetaNet repository. For example, the metaphor extraction system identifies the CM CORRUPTION IS A DISEASE, as illustrated by the following LMs:

(3) a. Chinese corruption will *infect* Hong Kong's orderly administration[19]
b. his fight to stop the *cancer* of corruption in Papua New Guinea[20]
c. The Congress is *plagued* by corruption[21]

This CM requires the structure of Corruption and Disease frames to align such that the inference of slow, ongoing action is available. Disease is a slow degenerative natural process that occurs over a period of time and whose effects are at first undetectable, but eventually may result in the destruction or significant disability of the entity, if not stopped. Likewise, after the Invariance Principle maps the proper inferences to the target domain, corruption is a slow degenerative social process that occurs over a period of time and whose effects are at first undetectable but eventually result in the destruction of social structure, if not stopped. In the metaphor analysis, the source domain Disease x-schema maps onto the target domain Corruption x-schema. To provide for the inference of these processes as slow and continual, the system elaborates x-schematic stages of Corruption and

19. ENGW_apw_eng_199603:11938

20. ENGW_afp_eng_200407:4591

21. ENGW_apw_eng_199604:35926

Disease: Ongoing Corruption and Development of Disease. Each stage provides the x-schematic information of ongoing_process and slow_rate.

While these stages may only be realized in our network as the result of a particular metaphor analysis, we emphasize that conceptually, the causal and dynamic variations represented by perspectives are generalized across all scenes, because all frames filling the source domains of metaphors are grounded in embodied primary experiences that are structured by very predictable force-dynamic patterns encountered in human interactions with the world. Just as all scenes ultimately inherit from shared highly schematized frames, all scenes too have the same causal and dynamic perspectives. These conceptual building blocks originate with the most general, high-level frames and are inherited by all subsequent frames of increasing specificity. This generalizability reflects the notion that conceptual structures are formed by composition of more basic, schematized structures, which is a basic tenet of embodied cognition. For example, Motion Along a Path is in part composed of the more general Source Path Goal frame, and Source Path Goal itself contains, in part, the still more general Trajector Landmark frame. The next section explores the nature of these frame relations in further detail.

3. Frame relations

Much like FrameNet's hierarchically-structured frame network, MN's system defines relations between the nodes (i.e. the frames, frame elements, and metaphors) of its network. As MetaNet constitutes a proposed model of cognitive conceptual structure, the representations of connections between frames (and metaphors, as discussed later) within the repository elaborate a hypothetical model of the relationships between conceptual structures as detailed in Cascade Theory (David et al., this volume; Lakoff 2008). Frame relations fall into two broad categories: structure-defining relations, and non-hierarchical relations.

3.1 Structure-defining relations

Structure-defining frame relations broadly resemble common ontological relations such as inheritance ("is-a") and composition ("has-a"). Like other inheritance relations, such as FrameNet's "inheritance" relation, the MetaNet *is a subcase of* frame relation denotes a hierarchical structure that connects elements of a more general parent frame onto corresponding elements of a more specific child frame. However, we do not consider this inheritance in the typical ontological sense, as the inherited elements are not copied or duplicated in the structure of the child frame. Rather, the child frame directly incorporates the semantics of its parent

frame and that of its parent's parent's frame, and so on; each corresponding element is not copied, but rather it is underlyingly a single conceptual structure with each child frame adding more semantic information to it. Thus, corresponding elements within this hierarchical structure are connected via *bindings*, which indicate that they are essentially activating the *same* concept. This is intended to accord with the hypothesis in neurocognitive linguistics that more complex conceptual structures are the result of neural networks that simultaneously activate multiple bound primitive structures located in various areas of the brain, such as motor-action neural bundles, sensory neural bundles, and visual neural bundles (Feldman 2006; Feldman & Narayanan 2004; Lakoff 2008). Those neural structures do not move or get copied; rather, they are activated as part of the spreading of neural activation as a whole.

The following sections describe the ontology of frame-frame relations developed by the MetaNet Project. As in other relational semantic systems, relations may be changed or added over time as analyses are refined and additional data prompt further development of the system. Table 4 summarizes MetaNet's current frame relations.

Several of the MetaNet frame relations are semantically comparable to FrameNet relations; however, some are unique to FrameNet or MetaNet (Table 5). In general, MetaNet structure-incorporating relations are more fine-grained than FrameNet relations. Future work will further consider potentially aligning the two into a unified representation framework.

3.1.1 Subcase of, special case of, *and* makes use of *frame relations*

Is a subcase of indicates a frame relation in which the elements of the more specific frame, which *is a subcase of* the more general frame, bind to all (*subcase of*) in the general frame. This relation can be compared with FrameNet's *inheritance* relation. We illustrate these relations with the high-level Purposeful Action frame (Figure 4), which is an image schema representing a scene of some action that an actor performs. It is a *subcase* of the even more general Action scene; thus, each element of the Purposeful Action frame binds to each element of the Action frame. Importantly, because Purposeful Action is a subcase of Action, all of the inferential structure associated with Action binds to Purposeful Action as well. This includes all of the type constraints specified for frame elements. The Action scene specifies that the actor role must be an Animate Entity; this constraint dictates that the actor of Purposeful Action must also be an Animate Entity. Because subcase frames fully bind the elements of their parent frames, they contain all the elements of their parent frames. However, because they are more specific instances of the parent, subcases must add some semantic information, such as elaborating on the parameters of roles or adding additional roles. Purposeful Action adds the

Table 4. Summary of frame relations.

	Frame Relation	Description	Example
Structure-defining relations	*is a subcase of*	full incorporation of frame structure	Purposeful Action *is a subcase of* Action
	is a special case of	no additional structure added	Boat *is a special case of* Seafaring Vehicle
	makes use of	partial incorporation of frame structure	Purposeful Action *makes use of* Desiring
	incorporates as role	frame fully included as an element	Eating *incorporates as a role* Food
	has affordance of	frame is an intrinsic property	Food *has affordance of* Eating
	is a process that makes use of	scene is incorporated into a perspectivized process	Experience Harm *is a process that makes use of* Harm to Living Entity
	profiles part of	foregrounds element of the frame	Curriculum *profiles part of* Education
	is a subscale of	profiles element of a scale	Light *is a subscale of* Luminosity
	is a subprocess of	profiles stage in a process	Diagnosis of Physical Affliction *is a subprocess of* Physical Affliction
Non-hierarchical relations	*is in causal relation with*	causal variants	Cause Motion Along a Path *is in causal relation with* Motion Along a Path
	precedes	temporal ordering between frames	Departing *precedes* Arriving
	mutually inhibits	frames are in semantic opposition to one another	Aids to Motion *mutually inhibits* Impediments to Motion
	is in scalar opposition to	opposite elements of a scale	Good *is in scalar opposition to* Bad

notion of intention or purpose such that the actor becomes an agentive actor and the action is performed for a purpose. To add this information, Purposeful Action *makes use* of the Desiring scene, which defines the semantics of purpose. Only some of the elements of Purposeful Action bind to those of Desiring, which distinguishes the *is a subcase of* relation from *makes use of*. In Figure 4, dotted lines indicate bindings and arrows indicate relations.

Table 5. Comparison of FrameNet and Metanet frame relations.

FrameNet	FrameNet Only	MetaNet	MetaNet Only
inherits from		*is subcase of*	
			is a special case of
uses		*makes use of*	
			incorporates as a role
			has affordance of
			is a process that makes use of
			profiles part of
			is a subscale of
subframes		*is a subprocess of*	
perspective_on		*is a perspective on*	
causative_of		*is in causal relation with*	
precedes		*precedes*	
			mutually inhibits
			is in scalar opposition to
	inchoative_of		
	see_also		

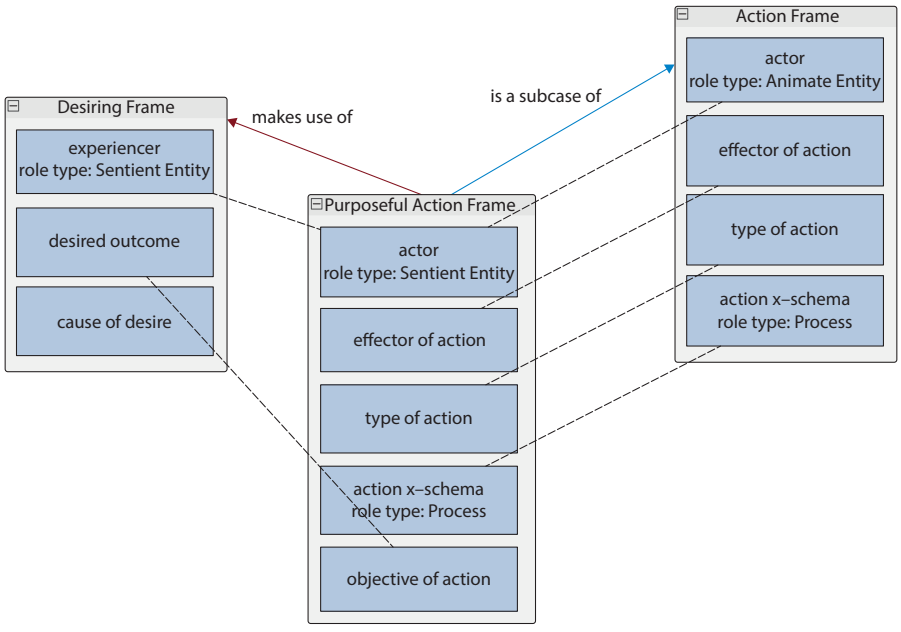

Figure 4. Bindings between Purposeful Action, Action, and Desiring frame elements.

Furthermore, when an element binds to multiple elements in other frames, the accompanying inferences must remain semantically coherent. Hence, when the actor of Purposeful Action binds both to the actor of Action and the experiencer of Desiring, the role constraints of Action's actor and Desiring's experiencer must be compatible. In this case, Action specifies an Animate Entity and Desiring specifies a Sentient Entity; because Sentient Entity and Animate Entity are both subcases of Entity, this double binding aligns properly, given the absence of incongruence for the semantics of each binding. Thus the actor role of Purposeful Action is of type Sentient Entity, which provides the inference of the ability to have the state of intention and purpose. In contrast, an element could not bind to both an Animate Entity role and a Machine role, as those roles are mutually incompatible frames. For an entity to be both living (Animate Entity) and an inanimate object (Machine) is self-contradictory in a semantic ontology of frame structures. (However, it is exactly this kind of construal that occurs in the context of metaphoric language, as will be seen in Section 4.)

The *special case of* frame relation is a type of *subcase of* relation in which the child frame only binds to one parent frame, with no additional frame relations; it only adds information by providing role fillers or otherwise filling the value of a parameter that is underspecified in the parent frame. Thus, the *Boat* frame is a *special case of* the Seafaring Vehicle frame.

3.1.2 Incorporates as a role *frame relation*

While child frames typically incorporate some or all of the structure of the parent frames by binding some or all of their frame elements to those of the parent frame, it may also be the case that a frame incorporates the entire frame itself as an element. While the *subcase of* relation creates a frame that is a more-specific version of the general frame, the *incorporates as a role* relation indicates that one frame fully includes another frame as an *element*. To put this another way, sometimes frame elements are entire frames in their own right and exist independently of the frame to which they are currently bound as a role. This situation occurs when two frames capture different perspectives on a scene, usually because one is focused on an Entity within the scene and the other on a Process occurring in the same scene. This approach allows the modeling of perspectives on scenes and information packaging. For example, Eating, which is a type of Process, is a scene which has a structure including the eater, the eaten_object, and the x-schema process of eating. Eating, as a Process, focuses on the interactive process between the eater and the eaten_object. The eaten_object (prototypically) is an edible object or substance, here termed Food. Food is modeled as a frame in its own right, which has much of the same structure as the Eating scene but focuses on the properties of the Entity being eaten and includes roles for type of food, amount of food, and properties

such as taste and texture. Thus, the network models the relation between Eating and Food by conceptualizing Eating as *incorporating* Food *as a role* within it; each frame portrays the same overall scene differently. Not all roles in a frame are *incorporated as a role* within that frame; some are represented only in terms of their representations within that frame. For example, the eater role in the Eating frame is only represented as a role within that frame; there is no independent Eater frame because the eater role (an entity which consumes food) can only be understood in terms of its relation to Eating. In contrast, because Food adds details regarding the properties of the eaten_object, it is a separate frame; therefore, its relationship with the Eating frame is understood as the Eating frame *incorporates* Food *as a role*. In summary, *subcase* relations exist between two frames of the same type — for example, Food and Beverage are both Entities, *subcases of* Consumable_Entity, whereas Eating is a Process that *incorporates as a role* Food, which is an Entity.

3.1.3 Has affordance of *and* process that makes use of *frame relations*

Conversely, whereas Eating *incorporates* the Food frame, we must also observe the relationship between Food and Eating. Food is inherently understood as something that can be eaten. While Processes *incorporate* Entities as participant roles, Entities similarly *incorporate* other frames as properties. Given this observation that certain Entity frames are defined in part by intrinsic properties, the *has affordance of* relation encapsulates the idea that the second frame is fully incorporated into the first and is central to the Entity's conceptual structure, but it is not a singular role within the frame.[22] For example, Liquid *has affordance of* Fluid Motion; the motion of fluid defines something as a Liquid. As the name suggests, the *has affordance of* relation is intended to capture formally the physical affordances of various real-world entities, and hence capture systematic generalizations about possible interaction scenes individuals may have with them.

A third type of frame incorporation occurs when a Process makes use of a scene or Entity, providing a processual perspective on it. As described in Section 2.2.1, the Harm to Living Entity frame includes both the harmful_entity and the victim. However, the metaphor ONGOING NEGATIVE STATE IS EXPERIENCING PHYSICAL HARM captures the notion of harm from the perspective of the victim (or "harm experiencer"). As metaphors often foreground the experience or perspective of particular entity roles within a non-perspectivized scene, the *process that makes use of* frame relation indicates that a frame such as Experience Harm is a process variant of a scene such as Harm to Living Entity, which incorporates the structure

22. A reviewer asked if one can assume that if Frame A *incorporates as a role* Frame B, then Frame B will always *have as an affordance* Frame A. While it is possible that Frame B will *have as an affordance* Frame A, it is not automatically ensured.

of the base scene and adds information from the dynamic perspective of a particular role, in this case the victim experiencing harm.

3.1.4 Profiles part of, is a subscale of, *and* is a subprocess of *frame relations*
As metaphors often foreground the experience or perspective of particular entity roles within a non-perspectivized scene, the *profiles part of* frame relation indicates that a frame such as Curriculum foregrounds an element of a complex scene like Education. This process of *profiling*, wherein some element or backgrounded component of a frame is brought into focus, is denoted with the *profiles part of* relation. Hence, Curriculum includes elements of Education related to the goals of lessons, information to be taught, and so forth, but it may not incorporate elements such as the students or administration.

Given that metaphor analysis drives the development of frame structure, one aspect of analysis entails categorizing metaphors into common types as well. The well-known orientation metaphors such as QUANTITY IS VERTICALITY, GOODNESS IS VERTICALITY, and CONTROL IS VERTICALITY[23] that Lakoff & Johnson (1980) described all rely on mappings between scalar structures in the source domain of Verticality and various target domains. Our approach emphasizes developing generic or generalized frames that can be elaborated into specific cases, thus recognizing that the entailments of the orientation metaphors (i.e., MORE IS UP and LESS IS DOWN are entailments of QUANTITY IS VERTICALITY) profile the end regions of the source and target domains. GOODNESS IS LIGHT/EVIL IS DARK, while not orientation metaphors, follow the same pattern of target and source frames with scalar structure — Goodness and Luminosity — with entailed metaphors that profile either end of each scale. Hence, GOODNESS IS LIGHT profiles the good, or light, regions of the Goodness and Luminosity scales, respectively; and EVIL IS DARK profiles the evil, or dark, regions of the Goodness and Luminosity scales. Observing this trend throughout a variety of metaphors relying on mapping between regions of scales dictates the need for the frame relation *is a subscale of*, to relate frames like Good or Light to the scalar scenes Goodness and Luminosity. This frame relation indicates that the child frame profiles one end region of the parent frame's scale. *Subscale of* constitutes a type of profiling in that an element (one scalar perspective) of a larger frame (the entire scale) is brought into focus.

The *is a subprocess of* relation also constitutes a form of profiling because it indicates that a frame is a particular stage of a multi-step complex process. Subprocess frames are developed as metaphor analysis identifies entailed metaphors that make use of these subprocesses within a larger metaphor network. For

23. These are non-perspectivized variants of the more traditional MORE IS UP, GOOD IS UP, and CONTROL IS UP.

example, the Physical Affliction scene might include the processes of affliction diagnosis, treatment, and cure. Identification of the metaphor SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS makes use of Physical Affliction in the source domain, as seen in the following LMs:

(4) a. poverty is *epidemic*[24]
b. Illegal drugs are a *cancer* on this and every other community in this country[25]
c. How do we *diagnose* poverty?[26]
d. the *misdiagnosis* of unemployment[27]
e. the best way to *cure* unemployment is to punish the unemployed[28]

Further analysis of these metaphors produces entailments of the main metaphor: ANALYSIS OF SOCIAL PROBLEMS IS DIAGNOSIS OF AFFLICTION (4c–d) and ADDRESSING SOCIAL PROBLEMS IS TREATMENT OF AFFLICTION (4e). Thus, the source and target domains of these entailed metaphors constitute processes within the source and target domain of SOCIAL PROBLEMS ARE PHYSICAL AFFLICTIONS, i.e. analyzing and addressing social problems in the target domain, and diagnosing and treating disease in the source domain. Identifying these entailments leads to the analysis of the subprocesses of the Social Problems and Physical Affliction frames, such that Diagnosis of Physical Affliction and Treatment of Physical Affliction are each *subprocesses of* the Physical Affliction scene frame.

3.2 Non-hierarchical relations

Non-hierarchical frame relations stand in contrast to structure-defining frame relations in that they are not structure-incorporating or hierarchically related to each other. Instead, these relations exist between sister frames with a common parent; their shared structure is via bindings to the shared parent, rather than as bindings between the frames themselves. These types of relations indicate that either the frames interact in a causal or temporal manner, or that they are variants of another frame. Hence, they are similar to FrameNet's "precedes" and "causative_of" and

24. ENGW_nyt_eng_199412:23202

25. http://www.news-gazette.com/news/local/2009-10-21/brothers-sentenced-20-years-hero-in-case.html

26. http://www.shapingdestiny.org/leadership/sdmleadership/defining-the-problem/

27. http://en.wikipedia.org/wiki/Keynesian_economics

28. BNC:CAJ:1062

"inchoative_of" relations, which capture temporal ordering or stative/causative and state change relations.

3.2.1 Is in causal relation with *frame relation*

Processes have causal variants, as previously illustrated in Table 3; any frame that inherits from Process will have perspectives that add causal information. For example, Table 6 recapitulates the causal variants of Motion Along a Path in comparison to the non-causal aspectual forms.

The main process scene, Motion Along a Path, has several aspectual forms elaborating various stages of the x-schema; each has causal versions that include information regarding the cause or prevention of activating that x-schematic information. The *is in causal relation with* relation describes the relationship between the causal and non-causal variants: Caused Motion Along a Path *is in causal relation with* Motion Along a Path. Caused Motion Along a Path does not provide any additional semantic information to the Motion Along a Path frame; the frame structures are the same, as are the core semantics of the frames themselves. The only difference is that the causal variant provides causal information, as illustrated in Figure 5 (dotted lines indicate bindings and arrows indicate relations).

3.2.2 Precedes *frame relation*

Whereas a causal relationship between two frames inherently implies a temporal relationship in that cause precedes effect, frames can also be temporally ordered without causation when they capture different stages of a process. For example, the Motion to a Destination frame includes the semantics of the stages of a journey: departing from the source location, traveling along a path towards the destination, and arriving at the destination. Each of these elements constitutes an element of the overall process; hence, Departing and Arriving are both *subprocesses* of Motion to a Destination. These sister frames are temporally ordered in relation to one another: Departing has to happen before Arriving. This temporal relation is codified in the *precedes* relation, such that Departing *precedes* Arriving.

3.2.3 Mutually inhibits *and* is in scalar opposition to *frame relations*

Finally, some sister frames are perspectives on a scene that are inherently in opposition to one another. These frames have a parent with an under-specified valence, which is parameterized in the child frames. The entity frames Aids to Motion and Impediments to Motion both describe Motion-affecting Objects, as evoked by such LUs as *ladder, trampoline, trap, shackle*. Something that enables movement inherently does not impede movement, and vice versa; thus the notions of enablement and impediment are in mutual opposition. The *mutually inhibits* relation is a symmetric relationship between two such frames: Aids to Motion *mutually inhibits*

Table 6. Comparison of aspectual and causal variants of Motion Along a Path frame.

Motion Along a Path Frames	Caused Motion Along a Path Frames
Motion along a path	Cause motion along a path Enable motion along a path Prevent motion along a path
Begin motion along a path	Cause beginning motion along a path Enable beginning motion along a path Prevent beginning motion along a path
Interruption of motion along a path	Cause interruption of motion along a path Enable interruption of motion along a path Prevent interruption of motion along a path
Resumption of motion along a path	Cause resumption of motion along a path Enable resumption of motion along a path Prevent resumption of motion along a path
End motion along a path	Cause end of motion along a path Enable end of motion along a path Prevent end of motion along a path

Impediments to Motion and Impediments to Motion *mutually inhibits* Aids to Motion. These frame relations can be compared to the relationship between lexemes such as *hit* and *miss*; both are consequences of the Hitting frame. In the case of *hit*, the consequence role of the Hitting frame is a successful hitting event, whereas in the case of *miss*, the consequence role of *miss* is an unsuccessful event. Therefore *hit* and *miss* are not mutually inhibitory in the same sense as Aids to Motion and Impediments to Motion, given that they both fill a role in the Hitting frame.

A special type of this opposition occurs when the two frames are each subscales of the same scale; Good and Bad are both *subscales of* Goodness, and Light and Dark

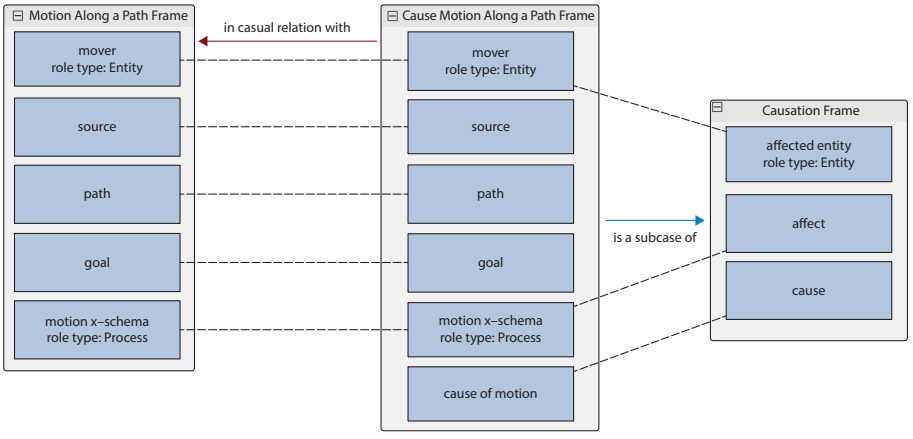

Figure 5. Relations between Motion Along a Path and causation frames.

are both *subscales of* Luminosity. As discussed in Section 3.1.4, the frequency with which these oppositions occur in basic metaphors, such as GOOD IS UP and BAD IS DOWN or GOOD IS LIGHT and BAD IS DARK, drives the analysis of the *subscale* relationship. Similarly, the core nature of these oppositions leads to the development of the *is in scalar opposition to* frame relation, which specifies this opposition between two subscales. As a specialized variant of *mutually inhibits*, it is also a symmetric relation: Good *is in scalar opposition to* Bad and Bad *is in scalar opposition to* Good.

4. Metaphors

4.1 Metaphoric construal

Fundamentally, primary CMs are mappings between frames that arise from human embodied experiences. The core of the conceptual network of metaphors are primary metaphors, such as STATES ARE LOCATIONS and CAUSES ARE FORCES, some of which are posited to be (near) universals (Grady 1997; Lakoff & Johnson 1999; Kövesces 2005). These basic metaphors comprise the backbone of more complex or culturally specific metaphors via cascades (David et al., this volume). A cascade is "a hierarchically organized conceptual combination of image-schemas, frames, and metaphors that has been used often enough to become fixed as a single complex entity" (David et al., this volume, p. 215). Drawing from formalisms developed in Embodied Construction Grammar, we propose that CMs are evoked by LMs via *role type constraint violations*, where a role type mismatch between individual lexical units in a given construct triggers a metaphoric interpretation of the sentence (see Stickles et al. 2016 for a discussion of role typing and constraint violations in metaphor).[29] The following LMs show a return to metaphorical construals of the LU "poverty" as introduced in Section 2.2.1:

29. A reviewer raised the issue that there is not necessarily lexically evoked role-type constraint violation in cases such as *he fell in war* or *there's trouble ahead*, wherein *he fell* could be literal falling or metaphoric (i.e. death), and *trouble ahead* could be a literal troublesome thing on a path or metaphoric (i.e. in the future). While in isolation these readings are ambiguous and therefore problematic, in discourse context this is not an issue. The discourse context resolves the semantic referent of the potentially source domain-evoking terms; if it's clear from context that the narrative refers to future events, then *ahead* is likely to be metaphoric rather than literal. This can be considered a case of role type mismatch at the discourse level rather than lexical level.

(5) a. poverty crushes *people*[30]
b. marginalized people already *injured* by poverty[31]
c. a country already handicapped by *crippling* poverty[32]

These LMs constitute three different grammatical constructions: (5a) contains the Subject-Verb construction, with the target domain LU in the subject and the source (*crushes*) as the verb; (5b) contains the Passive construction, with the target in the *by*-phrase adjunct and the source (*injured*) in the verb; and (5c) exemplifies the Adjective Noun construction, with the target in the noun and the source (*crippling*) in the adjective. While the syntax of each construction is different, the semantics of (5a) and (5b) clearly have an agent, either in the canonical subject position or demoted in the passive. Further, the semantics of all three source-domain LUs — *crush, injure, cripple* — convey the notion of a semantic patient being physically harmed by some injurious cause. Hence, these LUs all evoke the Harm to Living Entity frame, which has the entity roles and attendant role types depicted in Table 7.

Table 7. Entity roles and their role types in the Harm to Living Entity frame.

Entity role	Role type
cause_of_harm	Physical Entity
victim	Animate Entity

The frame element causing harm to the victim in the Harm to Victim frame is of type Physical Entity.[33] However, in (5a–c) above, the agent causing harm is the LU *poverty*, which evokes the Poverty frame; the corresponding role with this frame is of type Abstract State. Turning to an abbreviated form of the high-level frame network (Figure 6), we observe that *poverty* does not evoke a Physical Entity or one of its more specific descendants. Rather, *poverty* evokes an Abstract State frame.

In non-figurative usage, the LU filling the slot bound to the cause_of_harm in the Harm to Living Entity frame should be of type Physical Entity, such as *rock* in *the rock crushed the bug*. Hence, a type mismatch exists between Harm to Living Entity as evoked by *crush*, *injured*, and *crippling*, and the role type (Abstract State) of the frame evoked by the LU *poverty*. The conflict that arises between the

30. http://www.imva.org/Pages/stories/viewstory.asp?The+Burden+of+Poverty

31. http://dyinginhaiti.blogspot.com/2013/04/illness-as-moral-experience.html

32. http://www.concernusa.org/story/rebuilding-haiti-3-years-after-the-earthquake/

33. This state of affairs does not mean that the cause_of_harm must be of type Physical Entity; rather, cause_of_harm must be of type Physical Entity or a more specific frame that inherits from it, such as a Biological Entity or Animate Entity.

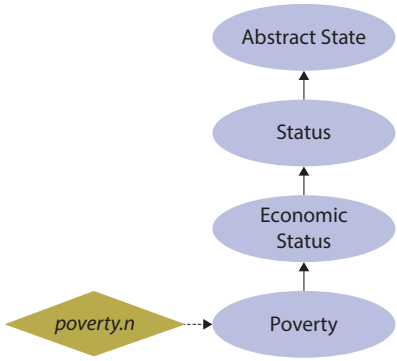

Figure 6. The LU *poverty* evokes the frame Poverty, which descends from an Abstract State frame.

incompatibility of Poverty and Harm to Living Entity triggers the metaphoric interpretation of the above LMs, and hence the CM, ECONOMIC HARDSHIP IS PHYSICAL HARM with its attendant mappings, as shown in Table 8.

Notably, the impoverished_entity of the Poverty frame and the victim of the Harm to Living Entity frame *are* type-matched, because Person inherits from Animate Entity. The specific type mismatch of impoverishment and cause_of_harm lead to the metaphoric evocation.

Further, (5c) shows a secondary type mismatch stemming from the LU *country*, which evokes the Social Group frame. Given that the target domain of ECONOMIC HARDSHIP IS PHYSICAL HARM is an impoverished_entity of type Person, the entity *crippled* by *poverty* should be of type Person. However, Social Group as evoked by *country* does not match this role type. Thus, another metaphoric reading is required for (5c) to produce the CM above correctly. The NATION IS A PERSON metaphor as illustrated partially in Table 9 conceptualizes the nation as an entity of type Person. Hence, by construing the country as an individual, (5c) evokes this metaphor to conceptualize the nation as an entity that can undergo harm.

Table 8. Mappings between roles and their role types in the ECONOMIC HARDSHIP IS PHYSICAL HARM metaphor.

Poverty			**Harm to Living Entity**	
entity role	**role type**		**entity role**	**role type**
impoverishment	Abstract State	<==	cause_of_harm	Physical Entity
impoverished_entity	Person	<==	victim	Animate Entity

Table 9. Partial structure of the NATION IS A PERSON metaphor.

Nation			**Person**	
entity role	**role type**		**entity role**	**role type**
nation_whole	Social Group	<==	person_self	Person

Role type constraint violations are similar to *selectional preference violations*, which are a violation of "a verb's predilection for a particular type of argument in a particular role" (Mason 2004: 23). CorMet measures selectional preference by identifying high-frequency verbs associated with particular semantic domains and by calculating the WordNet node(s) (which include the descendants of the nodes) most likely to fill the case slots of the verb, as based on an input corpus. Selectional preference violations occur when an unexpected word occurs in a particular verb's case slot. This approach is usage-based and statistically-driven. In comparison, *role type constraints* are grounded in a theory of cognition that specifies roles and roles types as features of the conceptual structure of frames. In practice, this approach is also usage-based in that the evidence for role types comes from analyses of corpora (Dodge, this volume).

4.2 Metaphor network

Given that Poverty is a negative state, ECONOMIC HARDSHIP IS PHYSICAL HARM must be closely related to the CM ONGOING NEGATIVE STATE IS EXPERIENCING PHYSICAL HARM, as discussed above. The Poverty frame is a subcase of the Negative State frame; therefore, we posit a more general metaphor: NEGATIVE STATES ARE PHYSICAL HARM. Thus, ONGOING NEGATIVE STATE IS EXPERIENCING PHYSICAL HARM is an experiential variant of NEGATIVE STATES ARE PHYSICAL HARM. These hierarchical relationships between metaphors are formalized in a fashion similar to the frame relations described in Section 3. One of the major innovations of formalizing CMT includes the development of the metaphor network, which parallels the frame network.

The following section illustrates how (primary) metaphors are related to one another in a conceptual lattice-like network, rather than an unstructured list. The core of the metaphor network is the primary/experiential metaphors such as the Event Structure metaphors and orientation metaphors. Metaphor relations are largely driven by the relations between the frames that constitute their source and target domains. By adding inferential structure to either domain, additional entailed metaphors of increasing specificity are produced. Starting with fundamental primary metaphors, a network that also includes culturally specific CMs such as ECONOMIC HARDSHIP IS PHYSICAL HARM is built up. The following section

discusses metaphor relations and further explores the nature of the network in the context of a fragment of the Location Event Structure metaphor (LESM).

4.3 Metaphor relations

Lakoff & Johnson's (1999) discussion of the LESM includes the examples in (6), among many others (Lakoff & Johnson 1999: 180):

(6) a. I'm *in* love.
b. He's *in* a deep depression.
c. She's *out* of her depression.
d. She's *close* to insanity.

Upon examining the frames evoked by the target domain LUs *love*, *depression*, and *insanity*, these four LMs all have target domains which are subcases of the highly schematized State frame: Emotion (6a–c) and Mental State (6d). Thus, these data illustrate perspectivized variants of the primary metaphor STATES ARE LOCATIONS; states are conceptualized as locations in which entities can exist in (6a–b) or out of (6c–d), with scalar physical closeness to the location corresponding to the scalar degree of the state (6d). Thus these LMs make use of variants of the frames State and Location in evoking variants of the metaphor STATES ARE LOCATIONS.[34] Given our prior analysis of the frame relationship between the State scene Negative State and the perspectivized Ongoing State, we observe that there is a consistent frame relation between experiential variants of scenes, such that Being at a Location *is a process that makes use of* the Location frame just as Ongoing State *is a process that makes use of* the State frame.

As semantic frames and the concepts that define them are the primary units of analysis in cognitive semantics, frame structure and relations between frames provide the foundation of metaphor structure and relations as well. Just as the internal structure of a metaphor maintains components of the structures of the frames that constitute its source and target domains, relations between two metaphors are informed by the relations between their respective frames. Metaphors are composed in a network with hierarchical, structure-defining, and non-hierarchical relations similar to the network governed by relations between frames. The source domains of metaphors tend to be those based in shared embodied experiences, whereas target domains are typically more conceptually abstract and viewpoint-dependent.

34. More specifically, STATES ARE LOCATIONS is atemporal; STATE EVENTUALITY IS LOCATION EVENTUALITY adds the temporal semantics of a process that can have some duration. Hence, aspectual and causal variants of STATES ARE LOCATIONS actually descend from STATE EVENTUALITY IS LOCATION EVENTUALITY, as will be illustrated in Figure 8.

Furthermore, because they are embodiment-based, source domain frames are more likely to have coherent and elaborated internal structure *independent* of metaphor. In contrast, highly abstract or intangible concepts like 'poverty' may have their frame structures shaped more by their usage in metaphoric construal, due to the more frequent tendency to reason about them metaphorically. For this reason, because the structure and relations of the source domain frames are less subject to conceptual contestation, metaphor relations are more likely driven largely by the more structurally specified source domain. (See David et al., this volume, for a more detailed discussion of the relatively contested nature of target vs. source domains.)

4.3.1 *Structure-defining metaphor relations*

Returning to the analysis of the metaphor illustrated in (6), the relationship between ONGOING STATE IS STAYING AT A LOCATION and STATES ARE LOCATIONS can be explored in terms of relations between their constituent frames. Just like structure-defining frame relations, structure-defining metaphor relations describe a hierarchical relationship between metaphors such that the structure of the higher-level metaphor — its frames, their roles, and the mappings between roles — is bound to those of the more specific inheriting metaphor. Again, because of the nature of the cascade, this information is not "inherited" in the traditional sense but, rather, it is directly incorporated via bindings. Hence with each more elaborate case, less elaborate cases are simultaneously active, rather than being copied into the more specific metaphor. Here, as Ongoing State and Being at a Location are identified as *processes that make use of* State and Location, respectively, the conclusion can be drawn that the metaphors that use them as target and source domains are in a structure-defining relation, given that *is a process that makes use of* is a structure-incorporating frame relation. The difference between STATES ARE LOCATIONS and ONGOING STATE IS STAYING AT A LOCATION can be understood when we consider the relationship between Location and Being at a Location: Location is a *scene* that includes the located_entity and the bounded_region. Being at a Location is *a process that makes use of* Location. This provides a dynamic, ongoing perspective on the Location scene that *foregrounds* the process. Therefore, the metaphor ONGOING STATE IS STAYING AT A LOCATION similarly foregrounds the ongoing process of experiencing a state as understood as the process of staying at a location. ONGOING STATE IS STAYING AT A LOCATION *structurally incorporates* STATES ARE LOCATIONS; the *structurally incorporates* metaphor relation describes any metaphor relation wherein one's frames are in structural relations with the other's frames. Further examples illustrate a specific variation on ONGOING STATE IS STAYING AT A LOCATION:

(7) a. *living in* poverty[35]
b. *mired in* crime and corruption[36]
c. caught in the debt *trap*[37]

Again notice the experience of negative states (Poverty, Crime, Corruption, Debt), this time conceptualized as locations in which entities exist (and in some cases are unable to get out of).

The role of temporal duration also bears noting here. The examples in (7) vary in their morphosyntactic realization of temporal information: (7a) is in the progressive, (7b) is a perfective atelic participle, and (7c) a perfective telic participle. However, all of them convey a notion of the experience of a state for some duration of time. This aspectual construal is enabled in part by the compatible lexical semantics of the source and target domains of each LM; *living*, *mired*, and *caught* are all verbs indicating an ongoing event. Similarly, *poverty*, *crime*, and being in *debt* are all eventualities as well. Returning to the frame analysis of x-schema structures in Section 2.2.2, note that all frames which incorporate x-schematic temporal structure will have aspectual variations available to them. Hence, the lexical semantics of the individual LUs participating in the LM must evoke frames with compatible x-schematic structure for the metaphoric mappings to be consistent. Which aspectual perspectives are most commonly occurring, however, may be driven more by the target domain. For example, MN's system has extracted 13,658 metaphoric expressions with the target domain lemma "poverty" from the corpus. There are over twice as many LMs about living or existing in poverty (854) as there are about leaving poverty (416), as shown in Figure 7.

From this distribution of the source domain language, a reasonable conclusion is that poverty, when metaphorically conceptualized as a location, is more commonly thought of as a location that people exist in (i.e. as a durative state) rather than a location people leave (i.e. as cessation of a state).

The fact that all the LMs in (7) evoke a negative state suggests a more specific metaphor: ONGOING NEGATIVE STATE IS STAYING AT A LOCATION. Ongoing Negative State is a *subcase* of Ongoing State, the target domains of their respective metaphors. Given this *subcase* relation between the two target domains of ONGOING NEGATIVE STATE IS STAYING AT A LOCATION and ONGOING STATE IS STAYING AT A LOCATION, what follows is that the more specific metaphor *structurally incorporates* the more general metaphor, whose target domain does not specify the type of State. Compare the above with the following:

35. ENGW_afp_eng_199405:9440

36. http://www.straighttalktt.com/media/?cat=21

37. ENGW_xin_eng_199511:26479

(8) a. the *pits* of poverty[38]
b. The Philippines has stumbled over reform and is now *sunken in* corruption[39]
c. help Mexico *climb out* of debt[40]

In these examples, Negative States continue to be metaphorically construed as Locations, but they are specifically *Low* Locations via an additional basic metaphor, BAD IS DOWN. In this case, the source domain Staying at a Low Location is a *subcase* of Staying at a Location. Given this *subcase* relation between the two frames, the consequent metaphor ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION *structurally incorporates* ONGOING NEGATIVE STATE IS STAYING AT A LOCATION. The frame Staying at a Low Location *is a process that makes use of* Low Location (*a subscale of* Verticality), which is the source domain of BAD IS DOWN. Ongoing Negative State *is a process that makes use of* Negative State (*a subscale* of Goodness), the target domain of BAD IS DOWN. Both frames incorporate the scalar structure of the general scalar scenes by specifying the low/negative end of each scale. The scalar information in the source and target frames of BAD IS DOWN are accessed via *is a process that makes use of* relations between Ongoing Negative State and Negative State, and between Staying at a Low Location and Low Location. Hence, the *is a process that makes use of* relations between the frames involved in each metaphor result in ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION, incorporating the subscale valences of BAD IS DOWN and meaning that ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION must also *structurally incorporate* BAD IS DOWN; the partial network is illustrated in Figure 8 (dotted lines indicate bindings and arrows indicate relations).

Further comparison of the above source LUs reveals additional entailments of the general Being in a Location source domain: *mired, trapped,* and *sunken* all carry the inference of the inability to (easily) escape from the Location, whereas *climb out* brings with it the opposite inference: that of the ability to get out of the Location. Analysis of these variations requires beginning with the primary metaphor ACTION IS MOTION, which provides the basic structure of the metaphor PURPOSEFUL ACTION IS MOTION TO A DESTINATION via the intermediate metaphor ACTION IS MOTION ALONG A PATH. In (8b), the source LU evokes the Upward Motion frame, which is a *subcase* of Motion Along a Path. Thus, the Purposeful Action of becoming debt-free is Upward Motion, because Debt is already metaphorically construed as a Low Location. From this analysis we might propose the

38. http://www.cihadf.org/The-Edge-Initiative

39. http://www.freerepublic.com/focus/f-news/1044148/replies?c=1

40. ENGW_apw_eng_199606:73315

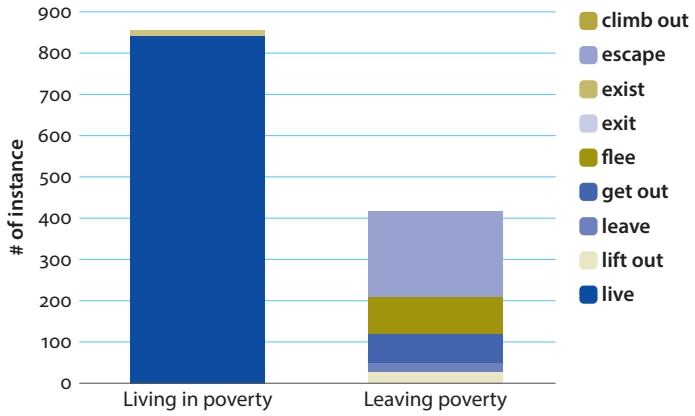

Figure 7. Frequency of lemmas related to existing in or exiting a location when used in metaphoric expressions related to poverty.

highly specific metaphor IMPROVEMENT OF STATE IS UPWARD MOTION as a specific entailment of ACTION IS MOTION. Whereas ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION is an entailment of STATES ARE LOCATIONS, adding ACTION IS MOTION to the analysis produces the understanding that CHANGE OF STATE IS CHANGE OF LOCATION. Therefore, if ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION and CHANGE OF STATE IS CHANGE OF LOCATION, what follows is that WORSENING OF STATE IS DOWNWARD MOVEMENT, an entailment of NEGATIVE STATES ARE LOW LOCATIONS and CHANGE OF STATE IS CHANGE OF LOCATION. Conversely, IMPROVEMENT OF STATE IS UPWARD MOTION. Entailed metaphors are highly specific variants that make explicit the inferential structure of a given metaphor. In this case, IMPROVEMENT OF STATE IS UPWARD MOTION draws on the inferential structure of GOODNESS IS VERTICALITY incorporated into WORSENING OF STATE IS DOWNWARD MOVEMENT: if a Negative State is construed as a Low Location and negative qualities the low region of a vertical scale, then an improvement of the State corresponds to upward movement from that low point.

Why propose such detailed entailments of the LESM? The elaboration of the nature of these specific entailed metaphors is directly driven by corpus data. Investigating differences in usage frequencies between individual lexemes that evoke different components of related source domain frames uncovers crucial differences in how people conceptualize and reason about target domains. Dodge (this volume) provides such a detailed exploration, focusing on the subtle distinctions in metaphoric construals of poverty. For a brief exemplification, consider the nuanced difference between *trapped in the pit of poverty* and *mired in poverty*. Both are from the viewpoint of the individual experiencing poverty and both portray poverty as a location that is difficult to escape, with the inference that successful

motion out of this location would mean that the individual has improved his/her economic status. Nonetheless, a *pit*, however deep, does not include the semantics of being truly physically stuck as in *mired*, which conveys the notion of some kind of extremely sticky situation. If the individual has a *rope* or a *ladder*, he or she might *climb* out of the pit. In contrast, it would be more difficult to extricate oneself if *mired* in a particular location. As these sorts of subtle variations in lexical choices in the data are observed by the analyst, additional entailed metaphors are in turn developed.

4.3.2 *Non-hierarchical metaphor relations*

Stopping the metaphor analysis at this point would miss a crucial generalization. The entailed metaphor IMPROVEMENT OF STATE IS UPWARD MOTION also derives from a much more general metaphor CHANGE OF STATE IS CHANGE OF LOCATION, a *perspective of* ONGOING STATE IS STAYING AT A LOCATION. There is an additional relation needed, the *perspective of* metaphor relation, which accounts for non-hierarchical relations. Whereas the *structurally incorporates* metaphor relation indicates that elements of one metaphor's frames are incorporated into the other's, the *perspective of* metaphor relation indicates that they are perspectives, such as aspectual or causal variants. For example, CHANGE OF STATE IS CHANGE OF LOCATION is an aspectual variant of STATES ARE LOCATION; CAUSED CHANGE OF STATE IS CAUSED CHANGE OF LOCATION is a second variant that further builds in causation.

The alternative nature of these metaphors follows from the simple inference that if an entity changes from one state to another, it no longer experiences the first state. This logic also applies to the primary experiential scene of being in a location: if an entity experiences the properties of a location while *in* that location, then when *out* of the location, those properties are no longer experienced. From this observation of perspective stages of both the experiences of states and experiences of locations, these alternatives also apply when state change is construed

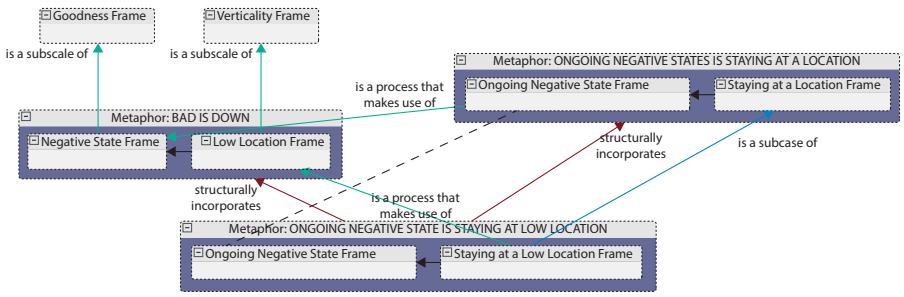

Figure 8. Metaphor and frame relations between ONGOING NEGATIVE STATE IS STAYING AT A LOCATION, ONGOING NEGATIVE STATE IS STAYING AT A LOW LOCATION, and BAD IS DOWN.

metaphorically as a perspective of the primary metaphor STATES ARE LOCATIONS. We may further conclude that if CHANGE OF STATE IS CHANGE OF LOCATION and CAUSED CHANGE OF STATE IS CAUSED CHANGE OF LOCATION, then PREVENTED CHANGE OF STATE IS PREVENTED CHANGE OF LOCATION. This notion of prevention of state change accounts for the entailed semantics of *mired, trap,* and *sunken* from (7b–c) and (8b–c), restated as (9a–d) with additional examples (9e–f).

(9) a. *mired in* crime and corruption
b. caught in the debt *trap*
c. The Philippines has stumbled over reform and is now *sunken in* corruption
d. help Mexico *climb out* of debt
e. *pulled from* the *abyss* of unemployment, hunger and poverty[41]
f. public education has long been a *ladder out* of poverty[42]

The LUs in (9a–c) each evoke a *subcase* of the Impediments to Motion frame: a specific kind of Low Location which prevents a change of location by impeding motion.

Finally, we consider some more complex examples in (9e–f). (9e) mirrors (9d) in that the former involves Upward Motion, as does the potential of upward movement in (9d). However, in contrast to *climb* (9d), the verb *pull* (9e) evokes Caused Upward Motion rather than a self-propelled motion. Based on prior analyses, the addition of causation suggests the metaphor ENABLED CHANGE OF STATE IS ENABLED CHANGE OF LOCATION, a perspective of PREVENTED CHANGE OF STATE IS PREVENTED CHANGE OF LOCATION. Whereas (9e) involves an external cause of upward movement, the *ladder* in (9f) provides a *means* to upward movement out of a location. This can be compared to (9b), where the *trap* is an instrument *preventing* movement out of location. Thus, as (9b) evokes PREVENTED CHANGE OF STATE IS PREVENTED CHANGE OF LOCATION, the examples (9e–f), in contrast, evoke ENABLED CHANGE OF STATE IS ENABLED CHANGE OF LOCATION. The LU *ladder* evokes the enabling_source role in Aids to Upward Motion, a *subcase* of the Aids to Motion frame. *Pulled* does not specify the means but, similarly, evokes externally caused motion. Impediments to Motion have the opposite force dynamics to Aids to Motion and, hence, are *mutually inhibitory*.

Prevented Change of State and Enabled Change of State similarly *mutually inhibit* each other as incompatible perspective stages of Change of State: by preventing change, enablement of change is also made impossible, and vice-versa. Thus, the two entailed sister metaphors PREVENTED CHANGE OF STATE IS PREVENTED CHANGE OF LOCATION and ENABLED CHANGE OF STATE IS ENABLED CHANGE OF

41. http://www.eurozine.com/articles/2014-09-03-majcen-en.html

42. ENGW_apw_eng_199512:21646

LOCATION are *perspectives of* one another. This metaphor relation reflects the mutually incompatible inferential structure of preventing and enabling state change. Because the semantics of preventing and enabling both imply a cause of the prevention or enablement, the frames of these metaphors constitute perspective variants of causation. In turn, the metaphors are *perspectives of* CAUSED CHANGE OF STATE IS CAUSED CHANGE OF LOCATION.

In addition to causal variants, the *perspective of* metaphor relation also describes the relationship between metaphors whose frames are aspectual variants. As described in Table 3, Begin Process is a *subprocess* (i.e. a perspective) of a Process; hence, Begin Change of State and Begin Change of Location are *subprocesses* of Change of State and Change of Location. The entailed metaphor BEGIN CHANGE OF STATE IS BEGIN CHANGE OF LOCATION provides an aspectual variant of CHANGE OF STATE IS CHANGE OF LOCATION that profiles the start of the metaphoric process. As described in Sections 2.2.2 and 3.1.4, subprocesses are stages of x-schemas or stages of processes (Narayanan 1997). These can be generalized as the beginning, ongoing stage, and ending of processes, with several intermediate stages. These *subprocess* relations between the source domains and target domains of the two metaphors show that BEGIN CHANGE OF STATE IS BEGIN CHANGE OF LOCATION *is a perspective of* CHANGE OF STATE IS CHANGE OF LOCATION. This partial analysis of the LESM is summarized in Figure 9 (solid connections are *structurally incorporates* relations; dotted lines represent *perspective of* relations).

5. Conclusions

The above analysis of the Location Event Structure Metaphor family is inherently a partial one. By treating x-schematic process variation and causal variation as separate perspectives that apply to any process, the conceptual network allows for the expansion of any Process scene into combinations of aspectual and causal variations. For example, Ongoing State has a causal variant Caused Ongoing State, which in turn has further variants Enabled Ongoing State and Prevented Ongoing State, with aspectual variations such as Enabled Beginning of Ongoing State or Enabled Resumption of Ongoing State, and so on. The combinatorial nature of the scenes, causal variants, and aspectual variants provides for an understanding of how the semantics of such a conceptual network relate. It is daunting for a human analyst to attempt to list or comprehend the nature of such a complex structure, particularly as additional scenes are added while data necessitate developing more frames.

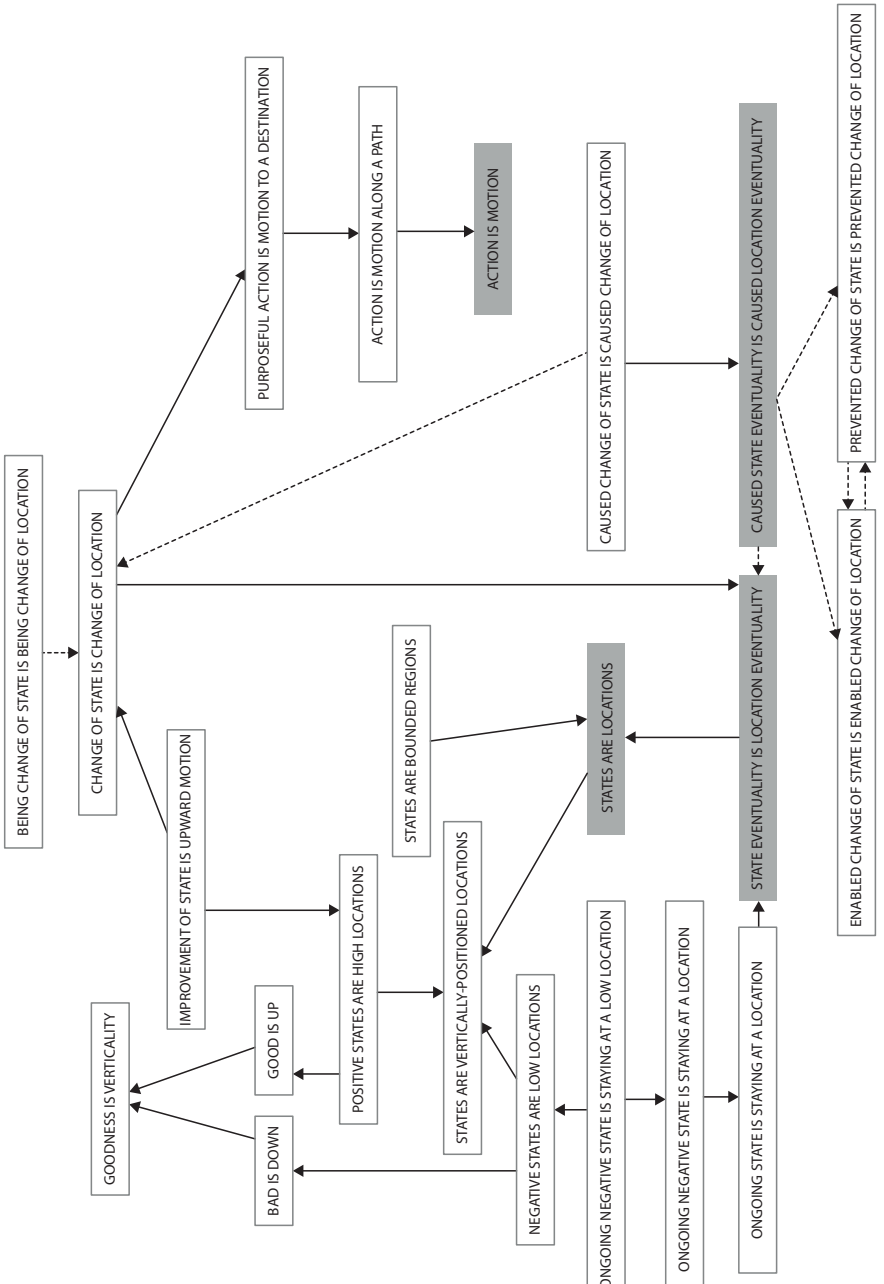

Figure 9. Relations between metaphors in the Location Event Structure Metaphor family.

5.1 Towards a computational implementation

These challenges for the human analyst are addressed in part by the computational implementation of CMT in MN's system repository. As each frame and each metaphor receives its own pages in a Semantic MediaWiki-based database (Krötzsch et al. 2007), they are easily viewed and edited by individual analysts. Live links between frames, metaphors, and frame elements instantiate the relations described in this paper. Hence, the network lattice is built into the repository, and as analysts add new frames and metaphors, the network grows. Additional visualization tools, such as automatically generated graphs and software that allow the analyst to perform advanced search queries, further enable the metaphor analyst to access a larger view of different aspects of the network. Because the wiki is an easily editable, familiar format, it is accessible to other linguists and researchers in a variety of fields; the underlying data can be downloaded and exported into other databases as well. All of this provides the possibility for greater collaboration among cognitive linguists and in allied disciplines. Furthermore, because the representations of frames and metaphors as instantiated in the wiki require the analyst to complete certain fields, performing metaphor analysis in this context is necessarily rigorous and thorough. The system has built-in constraints that guide the metaphor analyst's work; for example, the source and target domain entries must be filled in with frames. If the analyst chooses to use a frame not currently in the system, the system flags this fact, and the analyst must create the frame in order to continue. Similarly, if they specify that two frames or metaphors are related, the system will not let them complete their work without selecting the type of relationship. If the analyst chooses a structure-defining relation, the system automatically populates the binding fields with frame roles for the analyst to complete. As analyses are refined and additional structure added to frames, these changes can be automatically propagated throughout the network. The repository is publically accessible at the MetaNet website: https://metanet.icsi.berkeley.edu/metanet/.

In addition to a tool for metaphor analysis, this repository also provides the backbone of the system's automated metaphor extraction pipeline, as described in Dodge et al. (2015) and Hong (this volume). The network of frames and metaphors is accessed first via the lexical units associated with frames; a defined set of metaphoric constructions in conjunction with the metaphors and metaphor relations defined in the repository lead to the identification of LMs in a corpus. For example, the analyst can specify a set of source or target domains and the system will identify and annotate all the metaphoric linguistic expressions in a corpus that use the specified frames in metaphoric constructions. This metaphor extraction system will facilitate larger-scale, finer-grained corpus approaches to metaphor.

5.2 Summary

This paper details several more finely-grained frame-to-frame and metaphor-to-metaphor relations needed to account for the full lexical semantics of source domain triggers in linguistic metaphors. The MetaNet project formally represents these relations in a metaphor and frame repository. Computational methods employing these formalisms enables successful extraction of linguistic metaphors from the wild, with concomitant identification of the conceptual metaphors evoked by particular linguistic expressions. By representing frames and metaphors in a lattice-like hierarchical network, inferential structure is captured at highly schematized levels and propagated throughout, with subsequently greater degrees of specificity. This allows the representation of a shared conceptual structure throughout the network, such as the pervasive nature of the causal and aspectual variation in event structure, and accurately reflects the cascade theory of metaphor. Metaphor analysis is bottom–up and data-driven, as additional frames and metaphors are developed in response to observed lexical usage in naturally-occurring discourse.

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